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SEDIMENT TRANSPORT MODELLING IN THE UPSTREAM OF SUNGAI KUANTAN BY USING HEC-RAS

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Thesis submitted in fulfillment of the requirements
for the award of the
Bachelor Degree in Civil Engineering

Faculty of Civil Engineering and Earth Resources
UNIVERSITI MALAYSIA PAHANG

JANUARY 2018

ACKNOWLEDGEMENTS

Firstly, I would like to express my sincere thanks to my supervisor Mr. Norasman Bin Othman from Faculty of Civil Engineering and Earth Resources for being instrument in shaping my studies and for being the key figure whose constructive advice contributed immensely towards the completion of this study. Under his supervision, I have learned and gained a valuable knowledge that I cannot found out from the books. He guide and succors me to learn the software of HEC-RAS. Once again, thanks for all your guidance and comments that enable me to finish this final year project on schedule.

My gratitude and appreciation also goes to my family, especially my beloved parents Mr Nasir & Mrs Rozita. Thank you so much from the bottom of my heart. They give me warmest supports and advice during my research. They also aid me in term of financial. Besides that, I hereby would also like to thank all of my friends for their support and encouragement during these four years of studying in the university. To my other precious friends as well, you guys have left a mark of happiness and memories in my heart. This campus life would never be the same without your presence.

Last but not least, I have furthermore to acknowledge to lab assistant of geotechnical lab and lecture of hydraulic and hydrology for guide me to conduct experiment for carry out my research. The Faculty of Civil Engineering and Earth Resources had given me the support and approval for the project.

ABSTRAK

Stesen Bukit Kenau terletak di hulu Sungai Kuantan di negeri Pahang di mana terdapat banyak hujan semasa musim monsun yang membawa proses pengangkutan sedimen yang tinggi. Tanggapan sungai dengan meningkatkan atau mengurangkan kapasiti penyimpanan sedimen, berubah dalam bahagian rentas saluran, hakisan dan pemendapan sepanjang saluran, yang memberi kesan kepada kestabilan saluran sepanjang tempoh masa. Kajian ini adalah untuk mensimulasikan pengangkutan sedimen di sekitar Sungai Kuantan (Stesen Kenau) dengan menggunakan satu dimensi (1D) aliran tak mantap HEC RAS. Terdapat beberapa data yang diperlukan seperti data geometri, data hidrologi, data suhu dan data sedimen. Analisis ini dilakukan dengan menggunakan kaedah Tofaletti (kaedah yang sesuai) untuk pelbagai analisis tahunan iaitu satu (1), tiga (3), lima (5) dan sepuluh (10) tahun analisis. Dari simulasi dan hasilnya, morfologi sungai di dasar sungai dapat diramal. Hasilnya juga menunjukkan lokasi hakisan dan pemendapan berlaku. Untuk analisis simulasi sepuluh (10) tahun, hakisan maksimum berlaku pada kedalaman 1.47 m pada seksyen 44200 (4000 m dari hiliran). Sementara itu, pemendapan maksimum kira-kira ketinggian 2.39 m berlaku di seksyen 40800 (600 m dari hiliran). Oleh itu, lokasi yang sesuai untuk aktiviti perlombongan adalah di seksyen 40800 (600 m dari hiliran) kerana lokasi ini mempunyai nilai pemendapan yang tinggi. Kelebihan utama kajian ini ialah pengangkutan sedimen boleh diramalkan yang dapat memberikan kesan yang tinggi terhadap kestabilan saluran sungai dan isu-isu alam sekitar di sekitar sungai dapat dipelihara.

ABSTRACT

Bukit Kenau Station is located in the upstream of Sungai Kuantan the state of Pahang where subjected to huge amount of rainfall during monsoon season that bring high impact sediment transport process. The river responses by increased or decreased sediment carrying capacity, changing in channel cross section, erosion and deposition along the channel, which impact on channel stability over a period of time. The study is to simulate the sediment transport around Sungai Kuantan (Kenau Station) by using one dimensional (1D) quasi unsteady flow HEC-RAS. There is few data required such as geometric data, hydrological data, temperature data and sediment data. The analysis is done by using Tofaletti method (suitable method) for various year of analysis which are one (1), three (3), five (5), and ten (10) year analysis. From the simulation and results, the river morphology of the riverbed can be forecast. The result also shows the location of erosion and deposition occurs. After ten (10) year simulation analysis, the maximum erosion occurs at the depth of 1.47 m at cross section of 44200 (4000 m from the downstream). Meanwhile, the maximum deposition about of 2.39 m height occurred at cross section of 40800 (600 m from the downstream). Therefore, the suitable location for mining activities is at cross section of 40800 (600 m from the downstream) since this location has high value of deposition. The main advantages of this study is the sediment transport can be forecast which it can give high impact to river channel stability and environmental issues around the river can be preserved.

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LIST OF SYMBOLS

A	Cross section area
Q	Discharge
R	Hydraulic radius
P	Wetted perimeter
W	Top width

LIST OF ABBREVIATIONS

HEC-RAS	Hydrologic Engineering Centers River Analysis System
DID	Department of Irrigation and Drainage
ARC-GIS	Aeronautical Reconnaissance Coverage Geographic Information System

CHAPTER 1

INTRODUCTION

1.1 General

Malaysia today has been many changes in term of rapid urbanization. This development causes the changes of river catchment area since the surface run-off is increase due to increase in impervious area and resulting the flood is easy to occur. Numerous logging activities as shown in Figure 1.1 also makes serious issue because the effect of it activities can produce a high erosion to land surface and the volume of sediment will increase. The other effect that change the pattern of sediment transport in the stream is sand mining activity around the stream channel area (in-stream sand mining) (Department of Irrigation and Drainage, DID, 2009).

Figure 1.1: Logging activity around river catchment area

Sources: www.bharian.com.my/node/39349

Sediment transport is serious issue that need to consider since its lead to damage of the hydraulic structures along the river. Sediment transport also will affect the river morphology and channel capacity to convey or carry the flood water from upstream to downstream and can cause flooding.

Basically the sediment is divided into two which is bed load and wash load. For Sungai Kuantan, this two types of sediment is both existed since the colour of Sungai Kuantan is appear "muddy". Sungai Kuantan also have large impact during event especially during monsoon season (November to March). During flood, the river water level will increase and thus increase the flow rate of river channel. When the flow rate is increase, the amount of sediment transport expected to be increase.

Besides, during wet season in Kuantan, the colour of the river will become murky than before which means the wash load (part of sediment total load) is increase. This occur when erosion occur around the channel bank that happen from surface run-off increase during flood event. The aim of this study is to model sediment transport in upstream of Sungai Kuantan during wet season by using 1d quasi unsteady flow HEC-RAS. So that the real pattern of sediment transport and bed profile evolution at Bukit Kenau Station can be determined.

1.2 Problem Statement

Movement of sediment during flood event will increase and also will cause the several problems to the stream channel especially for stream bed. The sediment transport as bed load and wash load basically depend on the physical properties of the sediment such as grain size, density, and shape. The higher the velocity of flow of water also will affect the sediment transport. During wet season, the velocity of flow of water will increase and the amount of the sediment transport also will increase. The sediment transport also depends on in-stream sand mining. The sedimentation process is important to cover back the mining area so that the stream bad will balance. The increase in mining deep will need more sediment to cover the mining area and will cause the amount of sediment transport increase.

1.3 Objective of Study

The main objectives to be achieves in this study can be write down as follow:

i. To determine the suitable method to simulate the sediment transport of Sungai Kuantan.
ii. To simulate the water surface and river bed profile by using several method of transport function in 1D Quasi-Unsteady Flow HEC-RAS.
iii. To propose the suitable location for mining activities.

1.4 Scope of Study

The scope of this study is simulating the sediment transport by using 1D quasi unsteady flow HEC-RAS software. The simulation are using the data that collected from DID Kuantan. The simulation of sediment transport can be achieves after the collection of sample of sediment from Kampung Bayas at Sungai Kuantan. By determine the particle size distribution, the sieve graph can be plotted and put that data into HEC-RAS software so that the sediment transport modelling can be performed or simulated.

1.5 Significance of Study

After simulating the sediment transport modelling during wet season, the river morphology in the study area can be determined and simulated. By collecting a real data from DID Kuantan, a real situation about what will happens to the river morphology can be understood so that the sediment transport can be manages perfectly. Then, the suitable location of future sand mining activities can be proposed.

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